REMARKS/ARGUMENTS

In the Office Action dated February 13, 2004, the Examiner has objected to missing reference numerals on original drawings in FIGs. 5, 9, and 24. Appropriate reference numerals have been added to new submitted drawings for FIGs. 5, 9 and 24. The specification has also been amended to properly refer to the appropriate reference numerals. Also, the Specification has been amended to include reference to "425" of FIG. 19 to comply with 37 CFR 1.84(p)(5). Accordingly, no change is required in the original drawing of FIG. 19.

In the Office Action, the Examiner rejected Claims 1-21 under 35 U.S.C. §102(b) as being anticipated by Crean (U.S. Patent No. 5,745,249). Crean is directed essentially to a binary halftoning process (2-D process) with efficient memory access to have multiple output pixels (binary pixels) rendered in parallel and incorporates a resolution enhancement scheme that adds extra pixels to the rendered binary pixels and output with high-addressibility.

On the other hand, Applicants' invention provides for a gray level halftoning process (3-D process) with gray level pixels rendered, configured with two independent but parallel gray level halftoning processes with two different dot growth patterns, and composite two gray level pixels rendered into one gray level pixel output according to the blending coefficients for further edge enhancement. The edge enhancement described in this Application will modify the output by adding/subtracting values to those original rendered gray level pixels.

In a binary halftoning process, the rendered pixel is either on (black) or off (white) and has only one dot size. There are two major concerns in rendering a continuous tone image for printing: (1) the resolution of image details, and (2) the reproduction of gray scales. These two fundamental rendering factors compete with each other in a binary printing process. The more gray levels that are rendered, the larger a halftone cell. Consequently, coarse halftone screens are provided, with the attendant poor image appearance. However, with gray level halftone printing, one can satisfy both resolution and gray level requirements. In gray level printing, the same number of addressable dots are present, and there is attached a choice of dot sizes from one dot size

of 1 bit/pixel to for example 255 different dot-sizes of 8 bits/pixel. Gray level printing provides a higher image quality than binary printing.

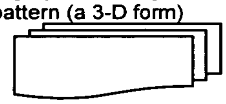
Further, the dot formation between binary dot and gray level dot is different. The binary dot is shown in the following illustration as 2-D dot growth pattern. It needs X &Y screen location to address the stored value in the screen cell. However, the gray level dot formation is much more complex than binary dot formation, it has 3-D dot growth formation (multiple planes) as shown in such illustration. It needs more than X&Y screen location to retrieve the stored micro-dot density value. Therefore, a binary halftoning process is different from gray level halftoning and should not be mixed together. Also, adding extra pixels to the rendered pixels is totally different from modifying by adding/subtracting values to those original rendered gray level pixels. As such, it is respectfully submitted that Applicants' invention cannot be inferred as being anticipated by Crean.

A graphic illustration of binary dot and gray level dot

A binary dot growth pattern (a 2-D form)

15	6	11	16
10	1	2	7
5	4	3	12
14	9	8	13

A gray level dot growth pattern (a 3-D form)



(Level 5 dot) A digital representation of rendered binary dot

0	0	0	0
0	1	1	0
1	1	1	0
0	0	0	0

A digital representation of rendered 2-bit gray level dot (a 2-D form)

0	0	0	0
0	3	2	0
0	0	0	0
0	0	0	0

More specifically, Crean discloses generating a "binary pixel value" or "binary dot". Crean describes essentially a "one brick" halftoning process in 2-D form and retrieval of multiple output (binary) pixels at once, while Applicants' invention describes a " two independent multiple-layer bricks" halftoning process in 3-D form and retrieve gray level pixels that will subject to blending operation (as shown in FIG. 3 of this Application). It is submitted that clearly there are substantial differences between

"gray level dot" and "binary dot" in dot formation and writer apparatus that mark the rendered image pixel on paper. There are also two other significant differences between the Crean patent and the present application. In the first, Crean teaches halftoning with a threshold (see Column 7, lines 36-46 of Crean) using the combination of the input pixel value and x,y coordinate information as an address. The threshold comparator makes the decision of turning the output binary information to either "on" or "off". Applicants' invention uses the x,y coordinate to identify the physical location of the halftone dot, and uses the input value to extract an output value (which is not binary, and no thresholding comparison occurs). Therefore the output value can be non-monotonic as density increases (different planes can behave differently in a 3-D dot, which is not the case for a 2-D thresholding case), and such value does not depend on neighborhood pixel selections. In the second, Crean teaches using multiple halftone screens within a single scan line (Column 8, lines 18-20, and FIG. 13 of Crean). However, each output pixel can only have one halftone screen choice. Applicants' invention uses blending technology so multiple halftone screens can be blended in the same pixel. In other words, using Crean's teachings cannot be held to anticipate (under 35 U.S.C. §102(b)), or in any way be said to teach, that which Applicants regard as the invention.

With regard to Claim 1, the Examiner has referred to column 4, lines12-20 of Crean, where Crean describes image definition with different forms (binary, gray scale, color coordinates) as an input image. It is submitted that this is not consistent with the specific recitation of Claim 1 for gray level rendered pixel. All of the dependent claims of this Application focus on the "gray level rendered pixel" and this is a substantial difference from Crean as pointed out in the paragraph above. Further, in column 6, lines 9-21, Crean describes the efficiency of the halftoning process where halftone design has a number of levels approaching the number of levels of input image data. The Examiner's conclusion is that it is easier in the halftoning process. However, this is not consistent with the recitation of Applicants' invention in Claim 1. In the claimed invention, pluralities of "output" halftoning planes are recited whereas Crean's process has in reality only a single halftone plane. In column 4, lines 12-20, Crean

describes the input image pixel, but in the invention of Claim 1 the output halftone rendered pixels are specifically recited.

Still further, in FIG. 1, and column 4, lines 61-64, column 5, lines 16-22, column 5, lines 23-27, and column 6, lines 28-35, Crean describes the halftoning process in brick form that is originated from the basic "Holladay" halftone technique. It is only a single layer brick which is not anticipatory of the invention recited in Claim 1. With Applicants' invention, there are 256 layers of tiles for 8-bit input image and many more layers of tiles for 12-bit input image. In column 5, lines 9-16, Crean describes the halftoning process in the "brick" process form and the brick contains a threshold value. Here again Crean does not anticipate that which is specifically recited in Claim 1. That is, Claim 1 recites plural layers of tiles arranged such that each microdot is associated within the tiles by coordinates and density values (i.e., Crean shows a 2-D halftoning process). Applicants' claimed invention is a 3-D halftoning process. There is a substantial difference between the binary halftoning process and gray level halftoning process, at the dot formations in rendered pixels for each process are totally different.

In FIG. 11, column 10, lines 5-12, Crean describes the implementation of the halftoning process including how to store addresses generated by the "brick" halftoning process in the memory for easy access. This does not anticipate the recitation in Claim 1 (as illustrated in FIG. 8 and 18a&b, 20a&b of FIG. 5). In column 7, lines 37-46, Crean describes an arrangement and implementation of efficient retrieval of multiple threshold values to be used in the halftoning process so that multiple output pixels can be output. Again this does not anticipate the recitation in Claim 1 which recites retrieval of the rendered pixels from buffers. Also, Crean outputs binary pixel form, while Claim 1 recites output in gray level pixel form. Essentially, Crean's teaching refers to using one brick and outputting multiple output binary pixels, whereas Applicants' claimed invention provides for using two multiple-layers of bricks and outputting a single blended gray level pixel.

As discussed above, descriptions from Crean are directed to an image-processing method with halftoning "input" image data. However, the significant differences between the invention recited in Claim 1 and Crean are related to "generating

a gray level rendered pixel value", "the microdot existing within one of a plurality of halftoning planes", storage, retrieving halftoned pixels, and the follow on blending operation. The Crean patent discloses generating a "binary pixel value" or "binary dot"; it describes essentially a "one brick" halftoning process in 2-D form and retrieval of multiple output (binary) pixels at once. On the other hand Applicants' claimed invention recites "two independent multiple-layer bricks" halftoning process in 3-D form and retrieval of gray level pixels that are subject to a blending operation (as described in FIG. 3 of this Application). As such, there are substantial differences between "gray level dot" and "binary dot" in dot formation and writer apparatus that mark the rendered image pixel on paper. Further, Crean discloses a selecting circuit method that selects only one halftoned pixel, which is different from the blending operation of Applicants' invention as described with reference to FIG. 3 of this Application. Still further, Crean discloses resolution enhancement by generating high-addressability binary dots (column 4, lines 54-60; column 6, lines 5-8), which is different from blending two rendered gray level pixels of Applicants' claimed invention.

As such, Crean cannot be interpreted to show, or in any way teach, using a microdot existing within one of a plurality of halftoning planes or the 3-D halftoning process, as now specifically recited in independent Claim 1, as amended. Therefore, it is respectfully submitted that the rejection under 35 U.S.C. §102(b) is no longer proper, and should now be removed. Accordingly, amended independent Claim 1, should now be allowed.

Regarding dependent Claim 2, Crean teaches a method to combine two inputs to address memory location for the thresholds stored. The threshold comparator makes the decision of turning the output binary information to either "on" or "off". On the other hand, Claim 2 recites that the stored value characterizes the values of micro-dots (and described further in Claim 4). Crean does not show, or in any way teach, using the x, y coordinate to identify the physical location of the halftone dot, and use the input value to extract an output value (which is not binary, and where no thresholding comparison occurs). Therefore, the output value can be non-monotonic as density increases (different planes can behave differently in a 3-D dot, which is not the case for a

2-D thresholding case), as now specifically recited in dependent Claim 2. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 2, should now be allowed.

With regard to dependent Claim 3, Crean describes (column 5, lines 5-8) the threshold to be used in the brick. Claim 3 recites that an average of density of whole tile characterizes the halftone plane. For example, if the average density of the micro-dots of the whole-layer in the current tile has a value 100, it represents that the 100th "output" halftone plane. There are 256 halftone planes being such as to represent 8-bit gray level output image. There is clearly, as discussed, significant distinction between 2-D thresholding process and 3-D extraction of an output value. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 3 should now be allowed.

Regarding dependent Claim 4, the definition of density value in the disclosure of Crean is a thresholding value which is not the value to be represented as density of the micro-dots in the halftoning process (column 7, lines 7-16 of Crean). It is the density value to be compared with input pixel value. In Applicants' claimed invention, the density value to be stored represents the density of micro-dots to be marked on the paper. Thus, there is substantial difference between the Crean teaching and that which is recited in Claim 4. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 4 should now be allowed.

With regard to dependent Claim 5, Crean teaches the output of the sequencer combining with input pixel value to form a single memory address to fetch a stored thresholding value (column 7, lines 17-22 and column 9, lines 1-22). Claim 5 recites that the stored density value may have different bits than the input halftone plane. For example, there are 256 input halftone planes; however, the stored density has only 0 to 15 values. Thus the output rendered halftone micro-dots have only 4-bit gray level pixels. Further, input halftone planes may not be restricted to only 256 planes which represent an 8-bit input image. Thus, "input" halftone planes and "output" halftone planes have different meanings in the claimed invention of this Application. Crean teaches edge enhancement (column 9, lines 1-22) with tags attached to a low resolution

image pixel so that output device can interpret and expand it to high resolution output to enhance the image. The high-resolution output has a higher number of pixels per inch (each pixel has single bits; it is adding pixels to the input pixel resolution), which is not what this invention recites relative to the number of bits output relative to input. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 5 should now be allowed.

With regard to dependent Claim 6, this claim recites input and output rendered pixels having the same bit-depth. For example, both are 8-bit image. The difference between input and output image is that the input is a continuous tone image while the output has been halftone processed with halftone structure embedded in the image. Each output pixel represents the density to be marked on the paper. Crean teaches resolution enhancement with higher bits (which is higher resolution) output (column 7, lines 17-22; column 7, lines 44-48; and column 9, lines 1-7). Thus, the definition of "bits" discussed in this Application is not the same as defined by Crean. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 6 should now be allowed.

Regarding dependent Claim 7, the stored value in memory of Crean has fixed dot growth pattern in 2-D form (because it outputs binary pixels) (column 4, lines 61-64; column 5, lines 23-24). On the other hand, Claim 7 recites mixed dot growth pattern in 3-D form (output gray level pixels). The dot formation is substantially different between binary dot and gray level dots. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 7 should now be allowed.

With regard to dependent Claim 8, this claim recites dual halftoning processes that have two different dot growth pattern density values (stored as described in 18 & 20 of FIG. 1; 18a & 20a, and 18b & 20b of FIG. 5). Crean teaches using multiple output pixels with dot growth pattern in 2-D using thresholding operation. As mentioned with reference to Claim 7, dot formation is significantly different between 2-D form and 3-D form. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 8 should now be allowed.

With regard to dependent Claims 9, 10, 11 and 12, the distinction between Applicants' recited invention and Crean is that Crean describes forming a memory address by combining a screen address with a pixel value to fetch a thresholding value in a 2-D brick structure (as indicated in FIG. 7 of Crean). Claims 9, 10, 11 and 12 recite fetching rendered pixels from a 3-D LUT structure. Crean does not show, or in any way teach, using microdots existing within one of a plurality of halftoning planes or the 3-D halftoning process, as now specifically recited in dependent Claims 9, 10, 11 and 12. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claims 9, 10, 11 and 12 should now be allowed.

Regarding dependent Claim 13, the Examiner refers to column 9, line 42-55 of Crean which discloses using multiple halftone screens within a single scan line (also see Column 8, lines 18-20, and FIG. 13 of Crean). However, each output pixel can only have one halftone screen choice and Crean cannot be interpreted as showing, or in any way teaching, using microdots existing within one of a plurality of halftoning planes or a 3-D halftoning process and using blending technology so multiple halftone screens can be blended in the same pixel. In other words, using the teaching of Crean does not enable one to anticipate that which is recited in Claim 13. Claim 13 recites a blending operation on two halftoning processes that composite two rendered gray level pixel values into one gray level pixel according to a blending coefficient (as indicated in FIG. 3 of the present Application). Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 13 should now be allowed.

With regard to dependent Claim 14, due to the fact that different dot growth patterns are used in different gray level halftoning processes, and blending coefficients result in edge smoothing effects in the rendered gray level image pixels, such edge enhancement method is substantially different from that taught by Crean which uses higher resolution binary output to enhance and smooth edges. Crean does not show, or in any way teach, using microdots existing within one of a plurality of halftoning planes or the 3-D halftoning process, and using blending technology so multiple halftone screens can be blended in the same pixel and then apply gray level edge enhancement processing

as specifically recited in Claim 14. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 14 should now be allowed.

Regarding independent Claim 15, the Examiner refers to FIG. 4; column 5, lines 9-16, lines 23-29 and lines 38-41; and column 6, lines 9-21 of Crean. Crean describes a 2-D halftoning process with easy memory access to fetch thresholding value. The threshold comparator makes the decision of turning the output binary information to either "on" or "off". On the other hand, Claim 15 specifically recites using the x, y coordinates to identify the physical location of the halftone dot, and using the input value to extract an output value (which is not binary, and no thresholding comparison occurs) via a LUT structure. Therefore the output value of Applicants' invention as now claimed can be non-monotonic as density increases (different planes can behave differently in a 3-D dot, which is not the case for 2-D thresholding). Crean does not show, or in any way teach, using a lookup table storing output gray level pixel values representing rendered values of a halftoning process into one of a plurality of halftoning planes (such as in the 3-D halftoning process), as now specifically recited in independent Claim 15, as amended. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, amended independent Claim 15 should now be allowed.

With regard to dependent Claim 16, Applicants' claimed invention recites the address calculator in an algorimetric way for the 3-D halftoning process (which is substantially different from 2-D halftoning brick process of Crean as previously pointed out in the opening remarks and with regard to Claim 15). Accordingly, Crean does not show, or in any way teach, using a 3-D lookup table structure storing output gray level pixel values representing rendered values of a halftoning process into one of a plurality of halftoning planes (such as in the 3-D halftoning process), as now specifically recited in dependent Claim 16. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 16 should now be allowed.

With regard to dependent Claim 17, the stored value referred to in Claim 17 is the density value of the pixel rendered. This is not the same as the method of Crean in which the stored value is a thresholding value and subject to comparison with the input pixel to render a binary output pixel. The thresholding value taught by Crean has nothing

to do with micro-dot density marked on the paper as recited in the claim of this invention. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 17 should now be allowed.

Regarding dependent Claim 18, recitation of Applicants' invention calls for a plurality of tiles of the micro-dots stored as structure for 3-D halftoning. On the other hand, Crean teaches a thresholding value stored in the brick for 2-D halftoning. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 18 should now be allowed.

With regard to dependent Claim 19, this claim recites how to store information in the tile which includes coordinates, density value, and input halftone plane value. As discussed above, Crean teaches a 2-D halftoning process. The halftoning information stored in 2-D halftoning is substantially different from halftoning information stored in 3-D halftoning (for example, the plane number will be missing in a 2-D implementation). Also, storing thresholding values for comparison is substantially different than storing output density, value for the planes (for example non-monotonic output density as a function of input value, and dot position function can be supported in a 3-D structure). Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claim 19 should now be allowed.

Regarding dependent Claims 20 and 21, these claims recite how to store halftoning information for the 3-D halftoning process. Crean, as discussed above describes a 2-D halftoning process. The halftoning information stored in 2-D halftoning is substantially different from halftoning information stored in 3-D halftoning as previously noted. Therefore, it is respectfully submitted that this rejection is no longer proper. Accordingly, dependent Claims 20 and 21 should now be allowed.

Applicants are not aware of any additional patents, publications, or other information not previously submitted to the Patent and Trademark Office which would be required under 37 C.F.R. §1.99.

This Application is now believed to be in condition for favorable reconsideration and early allowance, and such actions are respectfully requested.

Respectfully submitted,

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